



**Government of the Union of Myanmar
Ministry of Forestry
Forest Department
Forest Research Institute
Yezin**



**Studies on Seed Storage, Germination and Growth During
Nursery Stage of Some Indigenous and Exotic Species
Part - 2**

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**ပြည်တွင်းသစ်မျိုးနှင့် နိုင်ငံခြားသစ်မျိုး အချို့တို့၏ သိုလှောင်နည်းစနစ်
အစေ့ပေါက်နှုန်းနှင့် ပျိုးပင်အဆင့်၌ ကြီးထွားနှုန်းများကို
လေ့လာခြင်းအပိုင်း (၂)**

ဒေါ်သိန်းကြည် (B.Sc.(Bot.) (Mdy.)) ဒု-သုတေသနမှူး
နှင့်

ဦးမင်းကိုကိုကြီး (B.Sc.(For.) (Rgn.), M.Sc (ANU))ဌာနမှူး
သစ်တောသုတေသနဌာန

စာတမ်းအကျဉ်းချုပ်

သစ်တောစိုက်ခင်းများ အောင်မြင်စွာ တည်ထောင်နိုင်ရန်အတွက် သန်မာကောင်းမွန်သော ပျိုးပင်များ အလုံအလောက် ပျိုးထောင်ထုတ်လုပ်နိုင်ရန် အရေးကြီးပါသည်။ ပျိုးပင်များ ထုတ်လုပ်နိုင်ရေးအတွက် အစေ့စုဆောင်းခြင်း၊ သန့်စင်သိုလှောင်ခြင်း၊ အညှောင့်ပေါက်ခြင်းနှင့် ၎င်းတို့ ကြီးထွားနှုန်းတို့ကို ကြိုတင် သိရှိနားလည်ရန် လိုအပ်သည့်အလျောက် ပျဉ်းကတိုး၊ သစ်ကတိုး၊ ရင်းမာ၊ မအူကတုံး၊ ဂျုတ်၊ သင်္ဘောလက်ပံ၊ သင်္ဘောပန်းတမာ၊ ကဗွီးနှင့် ယူကလစ်စသည့် သစ်မျိုး (၁၀)မျိုးကို လေ့လာခဲ့ပါသည်။ ဤစာတမ်းတွင် သစ်စေ့ သိုလှောင်နည်း (၃)မျိုးနှင့် အစေ့ပြုပြင်နည်း (၂)မျိုးကို အသုံးပြုကာ စမ်းသပ် သိုလှောင်ပြုပြင်ခဲ့ပြီး အညှောင့်ပေါက်ခြင်းနှင့် ပျိုးပင်ငယ်ကြီးထွားနှုန်းတို့ကို တင်ပြဆွေးနွေး ထားပါသည်။

တွေ့ရှိချက်များမှာ ပျဉ်းကတိုး၊ လက်ခုပ်၊ ဂျုတ်၊ သင်္ဘောလက်ပံနှင့် သင်္ဘောပန်းတမာတို့မှာအအေးခန်းတွင် ကောင်းစွာသိုလှောင်နိုင်ပြီး သစ်ကတိုး၊ ရင်းမာ၊ မအူကတုံး၊ ကဗွီးနှင့်ယူကလစ် တို့မှာ ရေခဲသေတ္တာတွင် အကောင်းဆုံးဖြစ်သည်ကိုတွေ့ရှိရပါသည်။ အစေ့ပြုပြင်ခြင်းတွင် လက်ခုပ်၊ ဂျုတ်၊ သင်္ဘောလက်ပံ၊ သင်္ဘောပန်းတမာတို့အား ရေအေးတွင် စိမ်ခြင်း၊ ပျဉ်းကတိုးအား အစေ့အပေါ်ယံ အခွံ၏ တစ်စိတ် တဒေသအား ဖွင့်ပေးခြင်းဖြင့် အညှောင့်ပေါက်မှု များပြားတိုးတက်လာသည်ကို တွေ့ရပြီး၊ ကျန် သစ်ကတိုး၊ ရင်းမာ၊ မအူကတုံး၊ ကဗွီးနှင့် ယူကလစ် တို့မှာမူ ပြုပြင်မှုပေးရန် မလိုအပ်ကြောင်းတွေ့ ရှိရပါသည်။

ပျိုးပင်ငယ်များ၏ အရွယ်အစားသည် အညှောင့်ပေါက်သည့်နေ့မှစ၍ အနည်းဆုံး ၃၁-စင်တီမီတာ ရရှိရန်အတွက် လိုအပ်သော အချိန်ကာလမှ သစ်ကတိုး (၂၃၀)ရက်၊ ဂျုတ်(၂၂၀) ရက်၊ ပျဉ်းကတိုး (၂၀၀) ရက်၊ ကဗွီး(၁၈၀)ရက်၊ သင်္ဘောလက်ပံ (၁၈၀)ရက်၊ ယူကလစ် (၁၈၀)ရက်၊ ရင်းမာ (၁၆၀)ရက်၊ မအူကတုံး (၁၆၀)ရက်၊ လက်ခုပ် (၁၀၀)ရက် နှင့် သင်္ဘောပန်းတမာ (၈၀)ရက် တို့ဖြစ်ပါသည်။

Studies on Seed Storage, Germination and Growth During Nursery Stage of Some Indigenous and Exotic Species Part -2

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Abstract

Production of sufficient number of healthy and suitable size seedlings plays a very important role in the establishment of a successful forest plantation. In order to be able to plan in advance the right time for seed collection, storage, germination and growth of a required seedlings, (10) species i.e. Pyinkado, Thitkado, Yinma, Ma-u-kadon, Letkok, Gyok, Thinbaw-letpan, Kabwi, Thinbaw-pantama and Eucalypt were studied at the F.R.I, Yezin. Three different methods of storage and 2 different methods of pretreatment were employed and germination and growth were assessed. It was found that Pyinkado, Letkok, Gyok, Thinbaw-letpan, and Thinbaw-pantama stored well in air-conditioned room and Thitkado, Yinma, Ma-u-kadon, Kabwi, and Eucalypt gave good results when stored under refrigeration. Letkok, Gyok, Thinbaw-letpan, and Thinbaw-pantama gave the best germination when pretreated with cold water. Pyinkado increased in germination when partially scarified, while no pretreatment was need for the remaining species tested. To reach a plantable size of approximately 31 cm, Thitkado needed (230)days, Gyok (220) days, Pyinkado (200)days, Kabwi (180) days, Thinbaw-letpan (180) days, Eucalypt (180) days, Yinma (160) days, Ma-u-kadon (160) days, Letkok (100) days and Thinbaw-pantama (80) days.

Contents

	Page
စာတမ်းအကျဉ်းချုပ်	i
Abstract	ii
1. Introduction	1
2. Materials and Methods	7
Indigenous	7
Exotic	7
Seed Source and Time of Collection	7
Seed Collection	7
Seed Processing	8
Number of Seeds per Unite Volume and Unite Weight	9
Storage	9
Seed Pretreatment	9
(i) Soaking in cold water	9
(ii) Partial scarification	9
Germination	10
Transplanting	10
Height Growth	11
3. Results	11
Storage	11
Seed Pretreatment	18
Seedling Height Growth	26
4. Discussion	27
5. Conclusion	28
6. References	

1. Introduction

In 1987, a research paper titled Studies on seed storage, germination and growth during nursery stage of some indigenous and exotic species was produced and presented at the annual research congress held at Yangon. It is the first volume of a series of research papers dealing with methods of seed collection, processing, storage, pretreatment, germination and seedling growth rate. The species included were dahat, mezali, padauk, pauk-pan-byu, sit, than, thinbaw-kokko, yemane, auri sha, bawzagaing and senegal sha. The paper was prepared with the hope that it could be of some help to the country's plantation programme.

This paper is produced in continuation of the above mentioned paper and constitute the second part of the series. The objective and the technique applied were almost the same as its predecessor except for the species that were tested. There were ten new species included in this series two of which were exotics and the remaining eight were indigenous.

All the species selected in this paper may not be immediately useful in the country's plantation programme. However, important species that can be of immediate use were also included.

So far, studies have been carried out on as many species as possible. Since study on storage of some species may take three or more years, production of another volume of this series may also take time. However, the Division planned to produce volume after volume of this series as soon as data are available.

Figure (1)



(a) Pyinkado

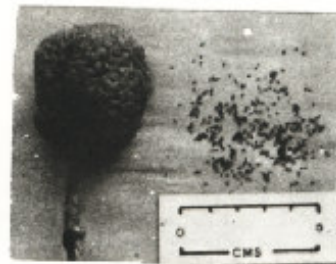


(b) Thitkado

Figure (2)



(a) Yinma

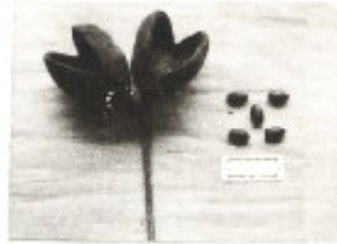


(b) Ma-u-kadon

Figure (3)



(a) Letkok



(b) Gyok

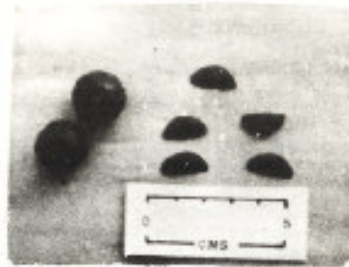
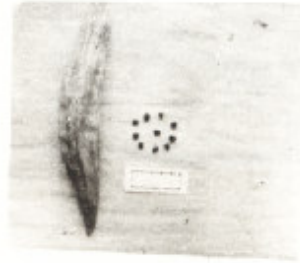
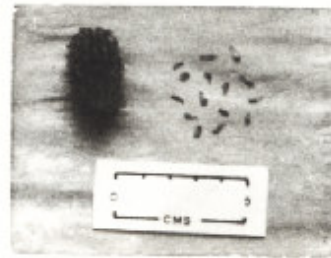


Figure (4)



(a) Thinbaw-letpan

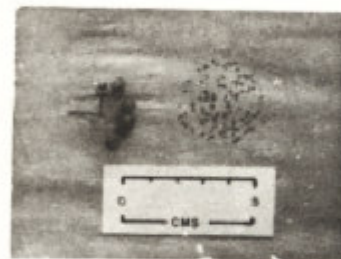


(b) Kabwi

Figure (5)



(a) Thinbaw-pantama



(b) Eucalypt

2. Materials and Methods

After seed collection in the field, experiments were carried out at the research nursery, F.R.I., Yezin. Out of the 10 species tested, 8 were indigenous and the remaining 2 were exotic. The species tested were;-

Indigenous

(1)	Pyinkado	(<i>Xylia kerri</i> Craib & Hutchison)
(2)	Thitkado	(<i>Cedrela toona</i> Roxb.)
(3)	Yinma	(<i>Chukrasia tabularis</i> A.Juss.)
(4)	Ma-u-kadon	(<i>Nauclea orientalis</i> Linn)
(5)	Letsk	(<i>Sterculia foetida</i> Linn)
(6)	Gyok	(<i>Diospyros montana</i> Roxb)
(7)	Thinbaw-letpan	(<i>Ceiba pentandra</i> (Linn) Gaertn)
(8)	Kabwi	(<i>Casuarina equisetifolia</i> Forst)

Exotic

(9)	Thinbaw- pantama	(<i>Melia azedarach</i> Linn)
(10)	Eucalypt	(<i>Eucalyptus camaldulensis</i> Dehnh).

Seed Sources and Time of Collection

	<u>Species</u>	<u>Sources</u>	<u>Time of Collection</u>
(1)	Pyinkado	Taungoo	February-March
(2)	Thitkado	Taungoo	April-May
(3)	Yinma	Yezin	February-March
(4)	Ma-u-kadon	Moeswe	September-October
(5)	Letsk	Pyinmana	February-March
(6)	Gyok	Yamethin	October- November
(7)	Thinbaw-letpan	Yezin	April- May
(8)	Kabwi	Yezin	February-June
(9)	Thinbaw- pantama	Yezin	September-October
(10)	Eucalypt	Yezin	June-July

Seed Collection

Very simple methods of seed collection were employed for the species tested.

Pyinkado, Letsk and Thinbaw-letpan were collected by climbing and picking with an extended pruner before the pods dehisce. Thitkado and Yinmawere collected by picking the capsule from the tree when the capsules turned from green to brown or reddish-brown. Fruits of Gyok, Ma-u-kadon and Thinbaw- pantama were collected by picking from the tree or shaking the trunks as soon as they were ripe and soft in texture. Capsules of Kabwi and Eucalypt were cut down from the standing trees by using an extended pruner when the capsules were well developed but still closed.

Seed Processing

Pyinkado - Collected pods were put in gunny bags and dried in the sun for 2-3 days. The pods dehisced and got separated from the seeds. The pure seeds were then removed and again dried in the sun for another 3 days, after which they were stored in the two respective storage conditions.

Thitkado - Collected capsules were put in bamboo mesh and dried in the sun for 3-4 days. The five-valved capsules dehisced and the light winged seeds were separated from the debris by winnowing. The pure seeds were then stored in the three respective storage conditions.

Yinma - Collected capsules were put in a bamboo mesh and covered with light wire mesh before being dried in the sun for 3-4 days. The capsules dehisced and the seed got separated. The brown, flat seeds with a brown membranous wing were separated from the fungus and insect infested seeds and inert materials by winnowing. After a proper sun drying for another (2) days, the dried seed were then stored in the three receptive storage conditions.

Ma-u- kadon - Collected soft ripe fruits were first made into thick paste water and then dried in the sun for 3-4 days. The dried materials were crushed and the minute seeds were separated from the inert materials by sieving repeatedly with different sizes sieves. The cleaned seeds were then stored in the three respective storage conditions.

Letkok - Collected pods were dried in the sun for 2-3 days. The pods dehisced and the seeds got separated. The seeds were then dried in the sun for another 2 days and then stored in the two respective storage conditions.

Gyok - When the collected fruits were soft in texture, they were macerated by rubbing them against a \pm "bamboo mesh under running pipe water. The pulp went through with the water while the cleaned seeds remain on the bamboo mesh. After being cleaned, the seeds were spread out in the sun to dry for 3 days. They were then stored in the two respective storage conditions.

Thinbaw- letpan - Collected pods were dried in the sun for 2-3 days. The pods which contain a quantity of creamy- white floss (kapok) burst open and disperse their contents of black, small pea-like seeds. The seeds were separated manually and then dried in the sun for another 2 days before being stored in the two respective storage conditions.

Kabwi - Collected fruits were spread out on racks to dry for 3 days. The one-winged, light brown samaras were separated from the fruits by shaking and screening. They were cleaned by winnowing and was ready for storage in the three respective storage conditions.

Thinbaw- pantama - The fruits, usually five- celled and five seeded, were absorbed in the water for 12 hours and the pulp floated off or screened out. The cleaned seeds were dried in the sun for 3 days and were ready to store in the two respective storage conditions.

Eucalypt - Collected capsules were spread out on canvas to dry for 2-3 days. Once the capsules were opened, they were shaken manually to remove the seeds. The viable

seeds were extracted together with unfertilized ovules, known collectively as chaff. Large impurities such as the remains of twigs, capsules, and leaves were removed by screening. Smaller impurities were removed by sieving in wire mesh. The seeds were then dried in the sun for 1 day and stored in the three respective storage conditions.

Number of seeds per unit volume and unit weight

Condensed milk tin (CMT) which is very commonly used as a measuring unit in Myanmar was used as a standard unit determining the number of seeds per unit volume. The capacity of (CMT) is equivalent to 320 cubic centimeter.

Seed lot of each of the tested spices were first divided down repeatedly until seed sample of the volume required is approximately reached. Assessment of the number of seeds per CMT was replicated three times and the average calculated.

Similarly, seeds of each of the species tested were sampled and the number of seeds per kilogram was assessed. One kilogram of seeds was weighted on an electrical precision balance and the number of seeds were counted. The process was also replicated three times.

Storage

Storage was done soon after the seeds were purified and dried in the sun. With the facilities available at the FRI, Yezin, three methods of storage were tested namely: (i) Storage under refrigeration (3°C), (ii) Storage in air-conditioned room (20°C-25°C), (iii) Storage at room temperature (30°C-33°C) respectively.

Pyinkado, Letkok, Gyok, Thinbaw- letpan and Thinbaw -pantama were stored and tested under (i) Air-conditioned room and (ii) Room temperature. Only Thitkado, Yiama, Ma-u-kadon, Kabwi and Eucalypt were tested under (i) Refrigeration (ii) Air-conditioned room and (iii) Room temperature.

Seed of all the species were put in air tight containers before being stored in the respective storage rooms.

Seed Pretreatment

Different pretreatment tests were carried out for different species as required. For the 10 species tested 2 pretreatment methods were used. viz (i) Soaking in cold water (ii) Partial scarification.

(i) Soaking in cold water

Letkok, Gyok, Thinbaw- letpan, Thinbaw -pantama and Pyinkado seeds were sampled and soaked in cold water for (24) hours. For each treatment four hundred seeds were germinated in a germination box containing pure sand. As control, four hundred untreated seeds were also included in the germination test. These were watered twice a day.

(ii) Partial scarification

Only Pyinkado was subjected to this pretreatment method. Four hundred seeds were clipped open slightly with a secateurs care had to be taken not to clip the seed at or near the micropyle and also not to damage the cotyledon. Only a slight opening which will allow water to permeate is sufficient. These and 400 untreated control seeds were then germinated

in a germination box containing pure sand treated with insecticide. These were also watered twice a day.

No pretreatment test was carried out for Thitkado, Yiama, Ma-u-kadon, Kabwi and Eucalypt as their germination rate were quite high.

Four hundred seeds were in all the germination testes of the species selected in this paper except for Ma-u-kadon. This is because Ma-u-kadon seeds were too minute to be counted. Instead of numbers, a unit of (0.5) gm was used for each germination test. This was again expressed in germination percent by using the number of seeds/gm which was previously counted in the laboratory.

Germination

All the pretreated and control seeds were germinated in a 61 cm x 61 cm x 15 cm germination box containing pure sand. The pure sand was treated with fungicide and insecticide. Germination was recorded daily and the germinated seeds were marked daily with bamboo tooth picks.

Thinbaw -pantama and Letkok were sown at an interval of $\frac{1}{2}$ cm on lines which were 5 cm apart. The depth of sowing was $1\frac{1}{2}$ cm and the seeds were covered loose sand. Watering was carried out with fine watering cap once at 8 am and once at 3 pm.

Pyinkado, Gyok, and Thinbaw-letpan, were similarly germinated except that the depth of sowing was 1 cm.

Germination of Thitkado, Yinma, and Kabwi which were very small seeds were sown at an interval of $\frac{1}{2}$ cm on lines which were 4 cm apart. The depth of sowing was approximately 0.8 cm. The seeds were then covered with light sand. Watering was done with fine spray once at 8 am and once at 3 pm.

Ma-u-kadon and Eucalypt were also sown on lines drawn at 4 cm apart and approximately 0.5 cm deep. Because of their small sizes the seeds were mixed with a little sand, before being sown so as to get them as equally distributed as possible. The seeds were then covered with fine sand. Watering was done with fine spray once at 8 am and once at 3 pm.

Germination was expressed both as germination percent and germination value. Method of calculation of germination value which expresses both the speed and totality of germination as development by Czabator (1962) was already presented in part 1 of this paper.

Transplanting

Pyinkado, Thitkado, Yinma, Letkok, Gyok, Thinbaw- letpan, Thinbaw-pantama and Kabwi seedlings were transplanted into individual containers when they have one pair of leaves. Seedlings of Ma-u-kadon were transplanted into individual containers only when they have two pairs of leaves while that of Eucalypt were transplanted when they have two to three pairs of leaves. On the other hand seedlings of Thinbaw- letpan were transplanted into individual containers before any leaf develop, i.e. approximately 3 days after germination.

The containers used were 17.8 cm x 7.6 cm polythene bags containing 1:2:6 mixture of sand manure and forest soil respectively. The seedlings that were pricked out from the germination box were first put in a bucket containing water before being transplanted into the polythene containers. This was done to avoid the roots from being getting dessicated. Transplanting is best done in the evening when it is cool. Watering was done with fine watering can twice a day.

Height Growth

Thirty seedlings of average and equal height were selected for height measurement. The seedlings selected were arranged in 6 rows of 5 seedlings. The rows were 15 cm apart and the inter-row spacing was also 15 cm. First measurement was taken at different age for different species as given below. Ma-u-kadon 90 days, Eucalypt and Kabwi 75 days. Gyok 60 days, Thitkado 45 days, Pyinkado, and Yinma, 30 days, Thinbaw- letpan, Thinbaw-pantama, and Letkok 15 days after germination. Subsequent height measurements were taken every 15 days until the seedlings were round a about 31 cm 1 foot height.

Height growth curve for each species were drawn by fitting the curve using the orthogonal polynomial method. The time taken to reach the height of 31 cm for each species was then read out from the graph. (See figure 11,12,13,14 and 15)

3. Results

The results of assessment of the number of seeds per unit weight (kilogram) and per unit volume (CMT) is as given table 1 below.

Table 1. Number of Seeds per Unit Weight and Unit Volume.

Sr. No.	Species	Number of Seeds	
		Per Kilogram	Per CMT
(1)	Pyinkado	3400-4000	850-900
(2)	Thitkado	352000-490000	8000-11000
(3)	Yinma	100000-160000	5000-8800
(4)	Ma-u-kadon	6800000-7000000	930000-960000
(5)	Letkok	600-700	100-140
(6)	Gyok	3000-5300	800-1070
(7)	Thinbaw-letpan	14000-20000	1900-2600
(8)	Kabwi	850000-870000	46000-53000
(9)	Thinbaw- pantama	3000-3700	600-750
		-	200-300
(10)	Eucalypt	2300000-2500000	300000-350000

Storage

The results of the effect of different methods of storage on germination was given in table 2 and figure 6,7,8,9 & 10.

Table 2. Effect of Different Storage methods on Germination

Sr. No.	Species	Storage	Germination percent (%)																																					
			1 Month	2 Months	3 Months	4 Months	5 Months	6 Months	7 Months	8 Months	9 Months	10 Months	11 Months	12 Months	13 Months	14 Months	15 Months	16 Months	17 Months	18 Months	19 Months	20 Months	21 Months	22 Months	23 Months	24 Months	25 Months	26 Months	27 Months	28 Months	29 Months	30 Months	31 Months	32 Months	33 Months	34 Months	35 Months			
1.	Pyinkado	(2)	89'	88'	89'	85'	85'	87'	88'	86'	83'	80'	80'	77'	78'	70'	71'	68'	63'	60'	57'	59'	50'	42'	45'	41'	38'	33'	30'											
		(3)	88'	87'	82'	80'	83'	61'	56'	58'	38'	39'	32'	35'	37'	35'	35'	33'	36'	25'	26'	20'	22'	21'	20'	16'	10'	7'	8'											
		(1)	69'	66'	67'	60'	60'	50'	55'	53'	49'	50'	44'	48'	52'	39'	30'	32'	21'	20'	9'	7'	4'	-	4'															
2.	Thitkado	(2)	62'	48'	45'	45'	42'	21'	10'	17'	19'	12'	5'	5'	8'	1'	2'	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		(3)	50'	46'	42'	15'	10'	5'	-	-	-	-	-	0.5'	0.2'	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
		(1)	73'	75'	72'	69'	73'	75'	70'	71'	76'	70'	75'	72'	74'	70'	68'	62'	60'	66'	67'	60'	64'	63'	60'	64'	62'	62'	60'											
3.	Yinna	(2)	70'	72'	70'	68'	70'	66'	62'	62'	60'	66'	64'	58'	60'	69'	65'	59'	66'	60'	64'	62'	58'	59'	53'	50'	52'	51'	48'											
		(3)	69'	58'	40'	37'	36'	18'	6'	3'	1'	-	-	0.7'	-	0.2'	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
		(1)	11'	13'	13'	13'	12'	9'	7'	7'	6'	6'	7'	7'	6'	7'	6'	7'	6'	7'	6'	7'	5'	5'	6'	6'	3'	2'	2'	1'	1'	0.7'	0.6'							
4.	Ka-u-kadon	(2)	9'	10'	11'	10'	9'	5'	5'	5'	5'	5'	4'	5'	5'	5'	5'	5'	5'	5'	2'	0.4'	0.2'	0.3'	0.3'	0.3'	0.1'	0.3'	0.1'	0.2'	0.1'									
		(3)	6'	14'	12'	8'	4'	2'	2'	0.1'	0.1'	-	0.2'	0.2'	0.2'	-	0.1'	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
		(2)	90'	72'	99'	79'	91'	79'	48'	63'	67'	60'	59'	43'	47'	61'	54'	45'	41'	40'	34'																			
5.	Letkok	(3)	90'	76'	93'	74'	94'	88'	34'	44'	56'	32'	47'	37'	36'	34'	19'	10'	19'	14'	7'																			
		(2)	80'	83'	85'	80'	78'	79'	63'	68'	60'	57'	57'	53'	55'	51'																								
		(3)	85'	82'	82'	72'	74'	78'	60'	45'	30'	16'	13'	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
7.	Thinbaw-letpan	(2)	64'	64'	60'	59'	61'	61'	63'	62'	58'	59'	57'	57'	51'	55'	56'	56'	50'	51'	53'	51'	52'	48'	49'	51'	40'	46'	44'	40'										
		(3)	66'	61'	65'	49'	55'	60'	53'	54'	50'	49'	51'	48'	45'	40'	39'	42'	44'	41'	40'	39'	41'	41'	38'	44'	25'	22'	16'											
		(1)	65'	66'	66'	65'	64'	60'	63'	63'	61'	60'	60'	60'	61'	60'	61'	58'	60'	60'	63'	60'	57'	57'	55'	56'	53'	50'	51'	47'										
8.	Kabwi	(2)	65'	61'	50'	48'	40'	42'	37'	37'	30'	29'	24'	20'	22'	21'	19'	17'	20'	14'	10'	7'	11'	13'	9'	4'	2'	-	-	-	-	-	-	-	-	-	-	-		
		(3)	66'	60'	52'	45'	39'	40'	35'	20'	12'	7'	3'	7'	1.5'	2'	5.8'	6'	2'	1'	-	0.7'	0.2'	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
		(2)	66'	63'	67'	51'	58'	45'	58'	51'	51'	47'	55'	60'	62'	53'	58'	60'	62'	55'	55'	58'	55'	58'	51'	51'	58'	59'	58'	48'	53'	55'	54'	53'	50'	42'				
9.	Thinbaw-pantama	(3)	63'	54'	55'	50'	55'	53'	52'	53'	51'	55'	50'	50'	51'	51'	52'	48'	49'	50'	50'	45'	51'	50'	39'	35'	31'	30'	24'	20'	22'	19'	15'	10'	-	-	-	-		
		(1)	83'	65'	79'	61'	58'	59'	65'	82'	58'	59'	66'	73'	66'	73'	64'	59'	65'	82'	66'	73'	63'	69'	70'	64'	70'	66'	64'	69'	70'	75'	60'	58'	49'	41'	53'			
		(2)	79'	73'	78'	60'	60'	63'	83'	73'	76'	59'	65'	80'	83'	63'	76'	65'	76'	73'	59'	65'	58'	62'	72'	63'	76'	57'	58'	54'	59'	65'	50'	38'	36'	38'				
10.	Eucalypt	(3)	77'	72'	72'	76'	62'	66'	59'	52'	55'	56'	40'	56'	42'	40'	45'	52'	56'	49'	58'	53'	53'	55'	49'	54'	50'	51'	56'	57'	53'	35'	16'	13'	2'	4'	8'			

Note. (1) Storage under refrigeration, (2) Storage in air conditioned room, (3) Storage at room temperature.

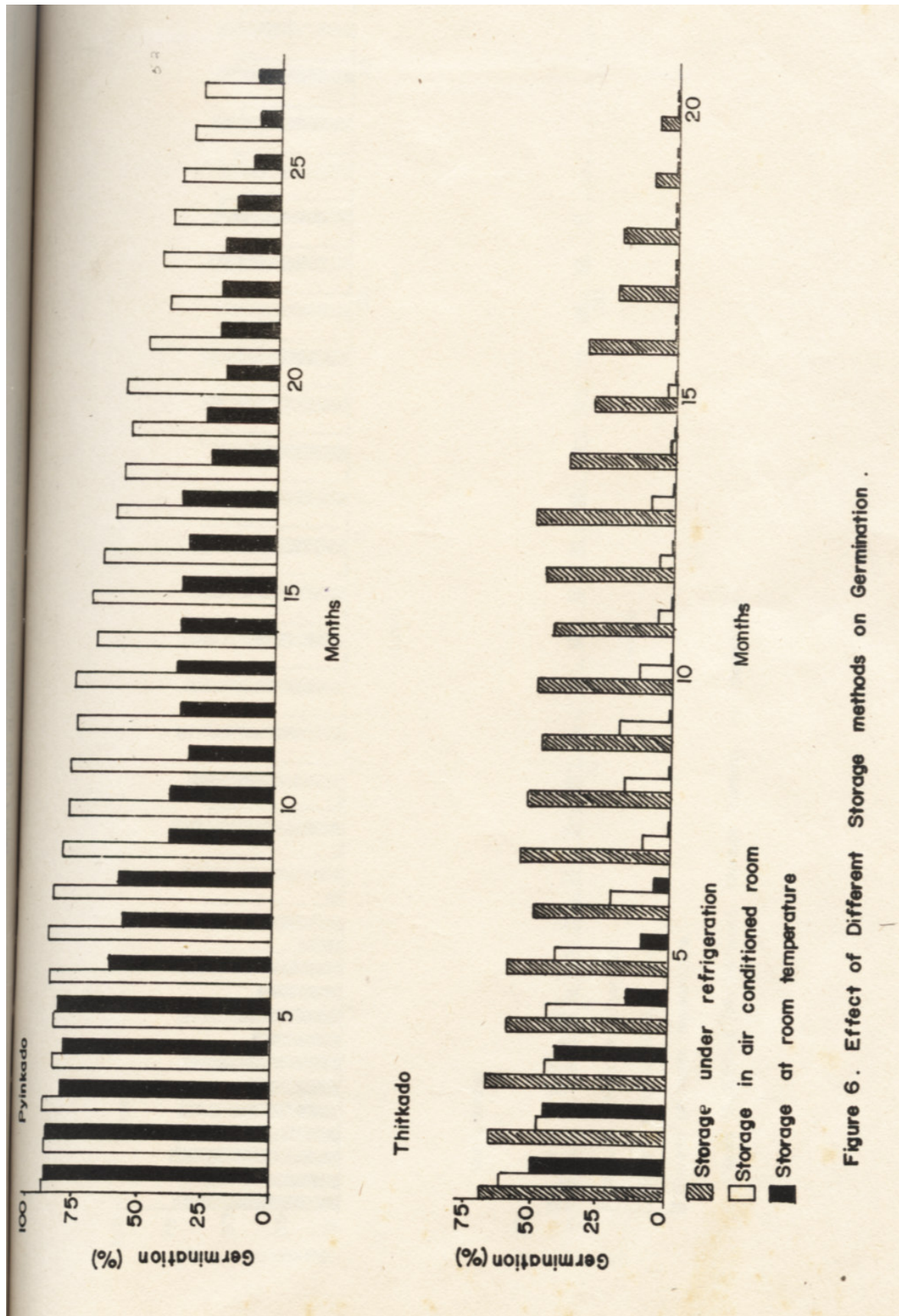


Figure 6. Effect of Different Storage methods on Germination .

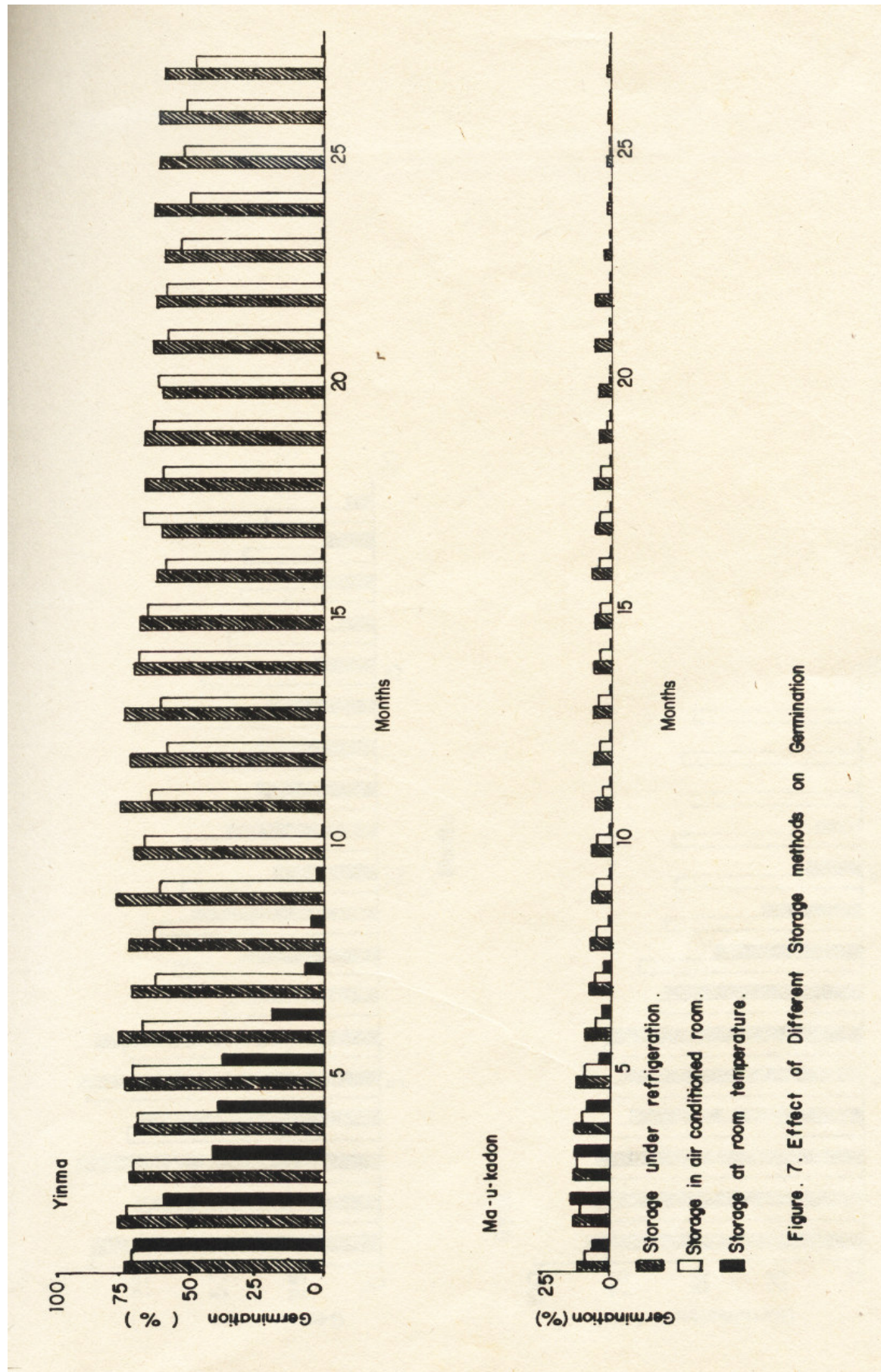


Figure. 7. Effect of Different Storage methods on Germination

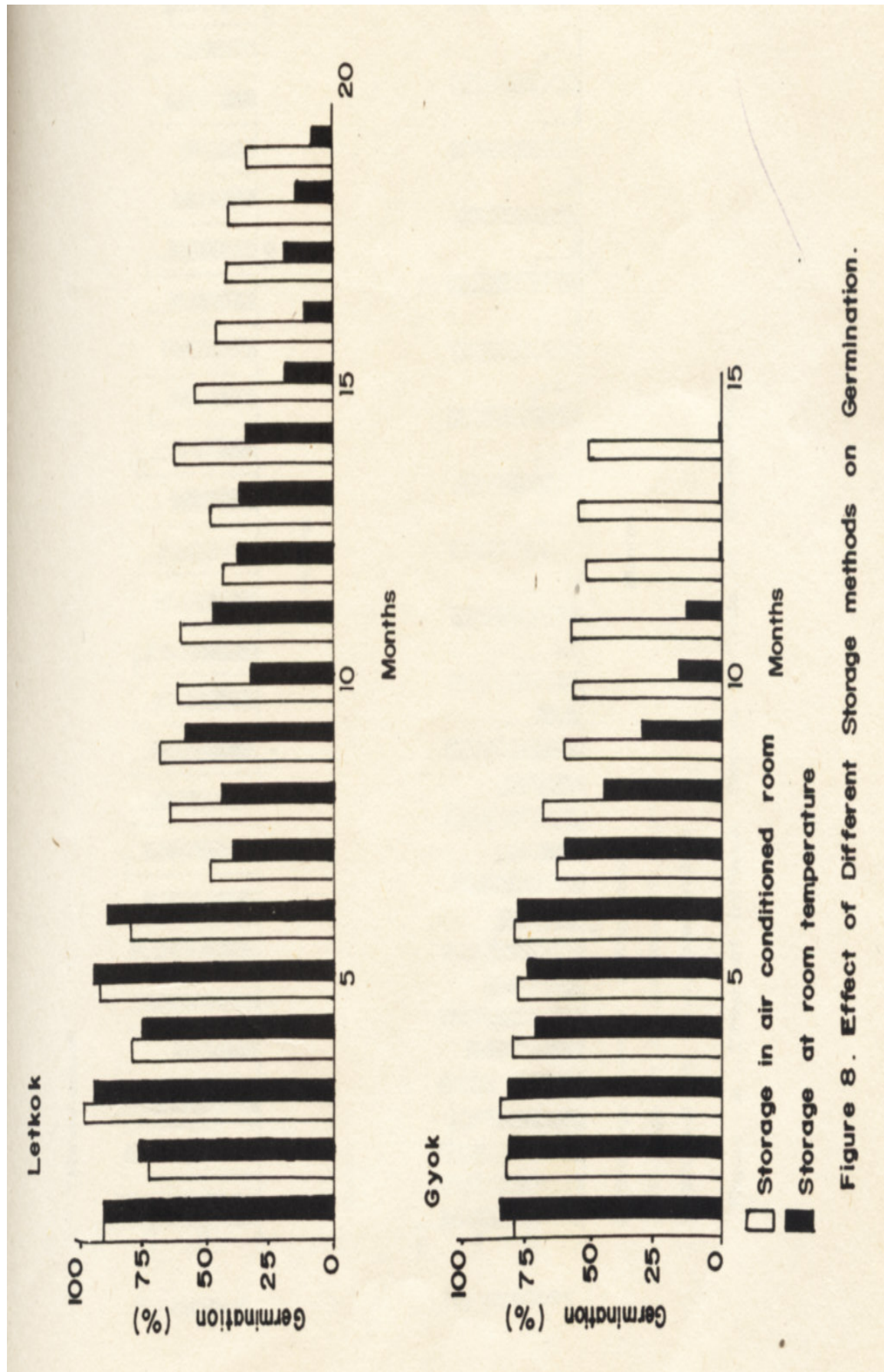


Figure 8. Effect of Different Storage methods on Germination.

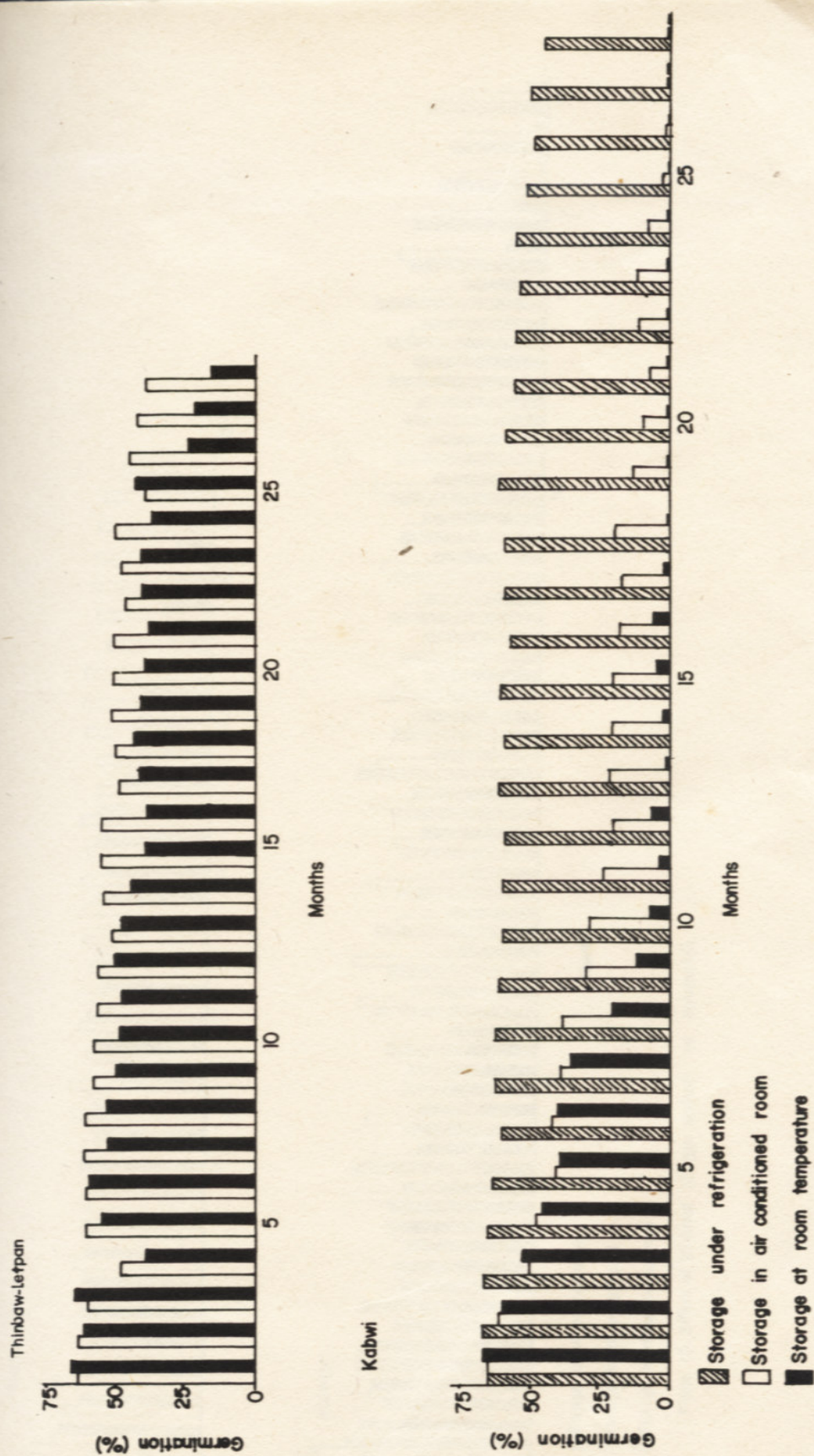


Figure 9. Effect of Different Storage methods on Germination.

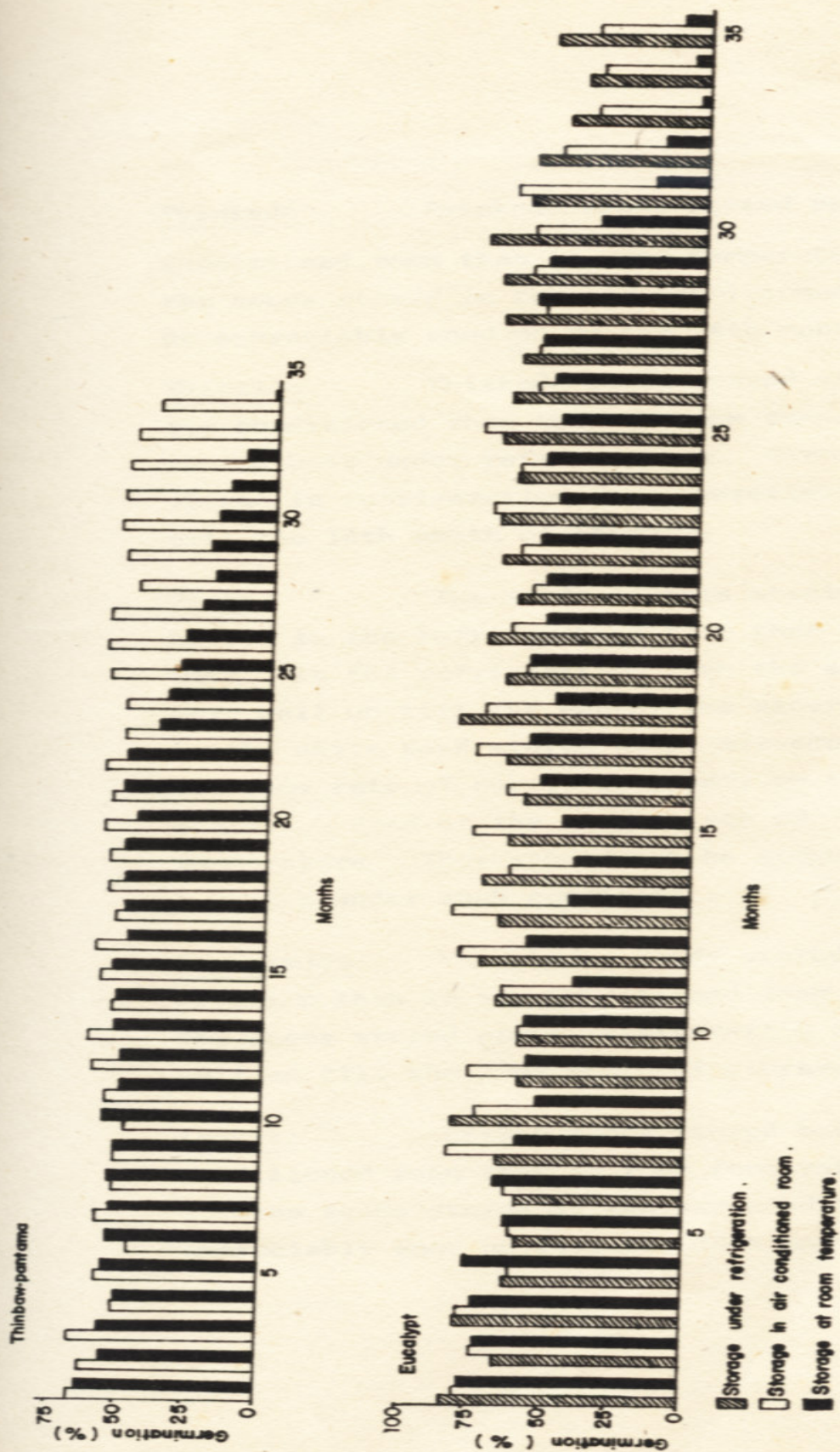


Figure 10. Effect of Different Storage methods on Germination.

Pyinkado - Pyinkado seeds stored better in the air-conditioned room than in room temperature. Germination for the seeds stored in the air-conditioned room was found to be appreciably good up to the 24th month of storage.

Thitkado - Thitkado seeds stored slightly better in the air-conditioned room than in room temperature. However, it stored best under refrigeration. Germination for the seed stored in refrigeration gave appreciably good results up till the 14th month of storage.

Yinma - The seeds of this species stored slightly better in the refrigeration room than the air-conditioned room. In the refrigeration room the seeds can be stored very well up till end of the experiment i.e. the 27th month, while seed stored under air-conditioned room can give the same rate of germination only up till 22th month of storage. Seed of the species stored very poorly under room temperature. They should not be stored for more than 5 months under such condition.

Ma-u-kadon - Ma-u-kadon seeds stored best in the refrigeration than in air-conditioned room and room temperature. The seeds stored under refrigeration germinated appreciably well up till the 22nd month of storage.

Letkok - Letkok seeds stored better in the air-conditioned room than in room temperature. Germination for the seeds stored in the air-conditioned room was appreciably good up till 18th month.

Gyok - Gyok seeds stored better in the air-conditioned room than in room temperature. Germination for the seeds stored in the air-conditioned room was appreciably good up till the end of the experiment on the 14th month.

Thinbaw-letpan - The seeds of this species stored slightly better in the air-conditioned room than in room temperature. Germination for the seeds stored in the air-conditioned room was appreciably good up till the end of the experiment on the 28th month.

Kabwi - Kabwi seeds stored best in the refrigeration room. The seeds stored in the refrigeration, germinate appreciably well up till the end of the experiment on the 28th month.

Thinbaw-pantama - The seeds of this species stored better in the air-conditioned room than in room temperature. The seeds stored in the air-conditioned room germinate appreciably well up till the end of the experiment on the 34th month.

Eucalypt - Storage of the seeds of this species was found to be the best under refrigeration. Storage in the air-conditioned room followed second while that under room temperature third. The differences of the effect of storage under these three conditions were however not very striking.

Seed Pretreatment

The effect of pretreatment on seeds of the species tested was as given in table 3.

Table 3. Effect of Seed Pretreatment on the Germination of Seed of the Species Tested.

Sr. No	Species	Soaking in cold water		Partial Scarification		Control	
		Ger. %	GV	Ger. %	GV	Ger %	GV
(1)	Pyinkado	78	63.42	87	124.13	62	15.9
(2)	Thitkado	-	-	-	-	69.7	25.6
(3)	Yinma	-	-	-	-	75	47.5
(4)	Ma-u-kadon	-	-	-	-	13	0.14
(5)	Letkok	90	58.57	-	-	75.25	10.85
(6)	Gyok	86	19.03	-	-	60	6.02
(7)	Thinbaw-letpan	61	21.18	-	-	55	5.65
(8)	Kabwi	-	-	-	-	66.25	4.27
(9)	Thinbaw- pantama	74	11.17	-	-	58.0	3.34
(10)	Eualypt	-	-	-	-	74.25	17.34

Table 4. Seedlings Height Growth

Sr. No	Species	Size Trans- planted (cm)	Height Measurement (cm)															
			15 days	30 days	45 days	60 days	75 days	90 days	105 days	120 days	135 days	150 days	165 days	180 days	195 days	210 days	225 days	240 days
(1)	Pyinkado	6.0	-	10.2	13.4	15.3	17.2	18.5	20.5	21.8	23.4	24.3	26.8	28.9	30.9	32.5		
(2)	Thitkado	2.5	-	-	4.3	7.6	11.5	14.6	16.5	18.6	19.7	21.4	22.9	24.3	26.6	28.3	30.3	32.2
(3)	Yinma	3.0	-	4.9	9.3	12.4	15.1	17.9	20.5	24.1	27.0	29.3	31.5					
(4)	Ma-u-kadon	1.8	-	-	-	-	-	2.9	6.1	13.1	19.3	25.5	34.3					
(5)	Letkok	5.0	6.9	10.5	13.2	19.9	25.1	29.3	31.5									
(6)	Gyok	2.5	-	-	-	-	4.5	5.1	5.5	6.7	8.7	10.9	15.8	20.1	23.9	27.4	30.2	31.9
(7)	Thinbaw-letpan	3.0	3.6	8.4	14.6	16.4	16.7	17.7	19.5	21.9	24.3	26.9	29.7	31.1				
(8)	Kabwi	4.0	-	-	-	-	8.4	11.2	12.7	16.7	19.8	23.8	27.8	31.5				
(9)	Thinbaw- pantama	3.0	3.4	5.6	14.7	22.5	27.5	34.4										
(10)	Eualypt	3.8	-	-	-	-	7.8	10.9	14.1	17.3	20.9	24.6	29.4	31.5				

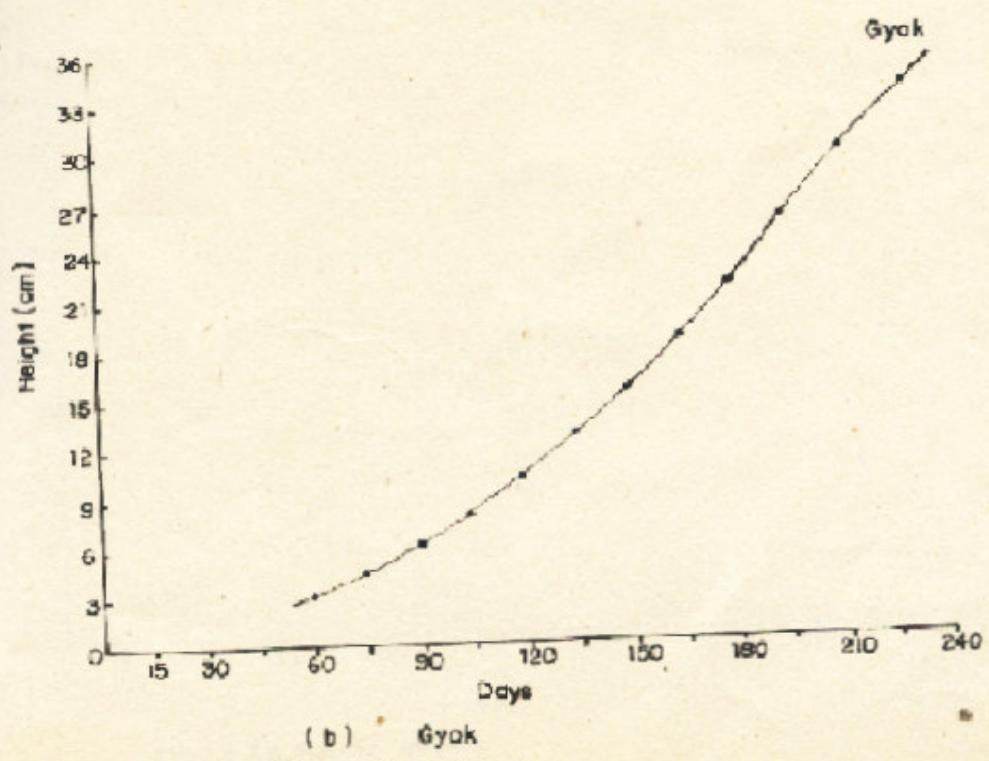
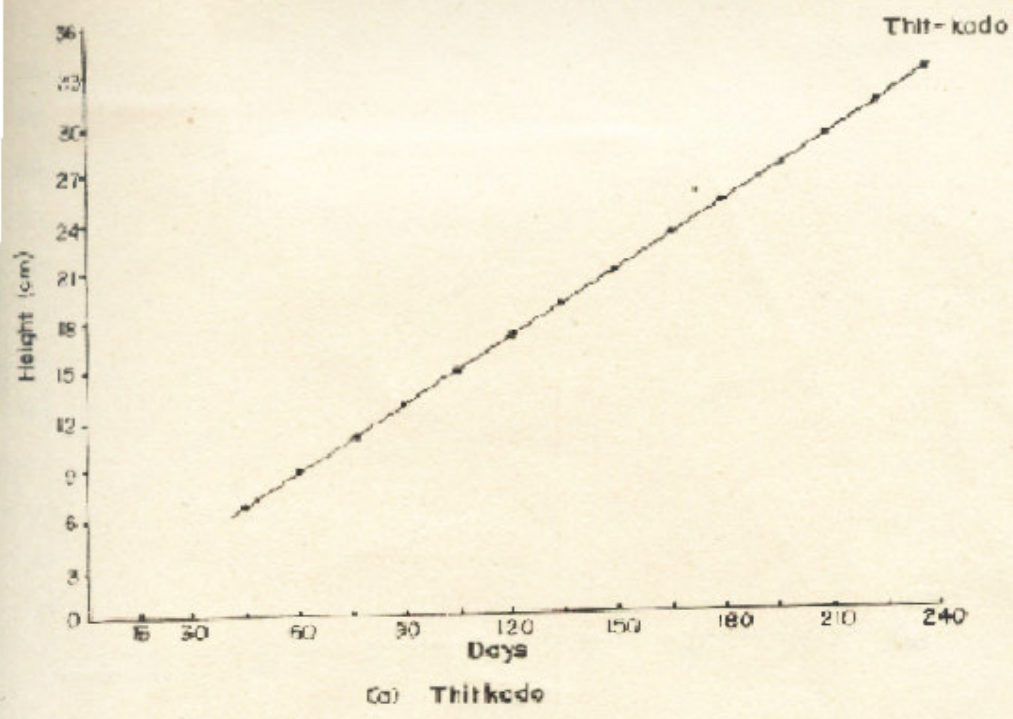


Figure 11. Height Growth

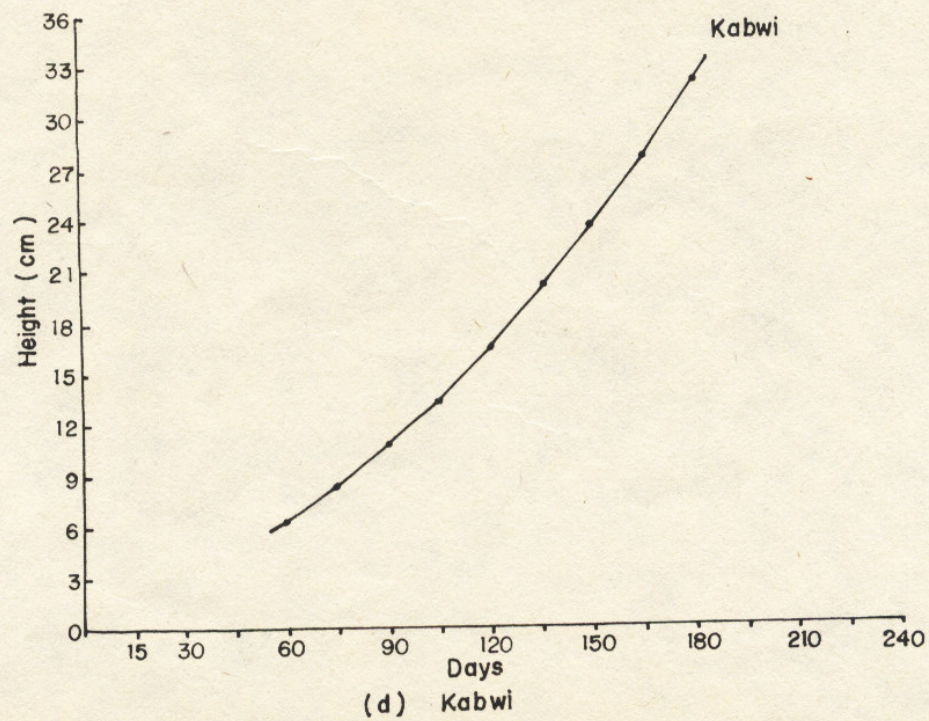
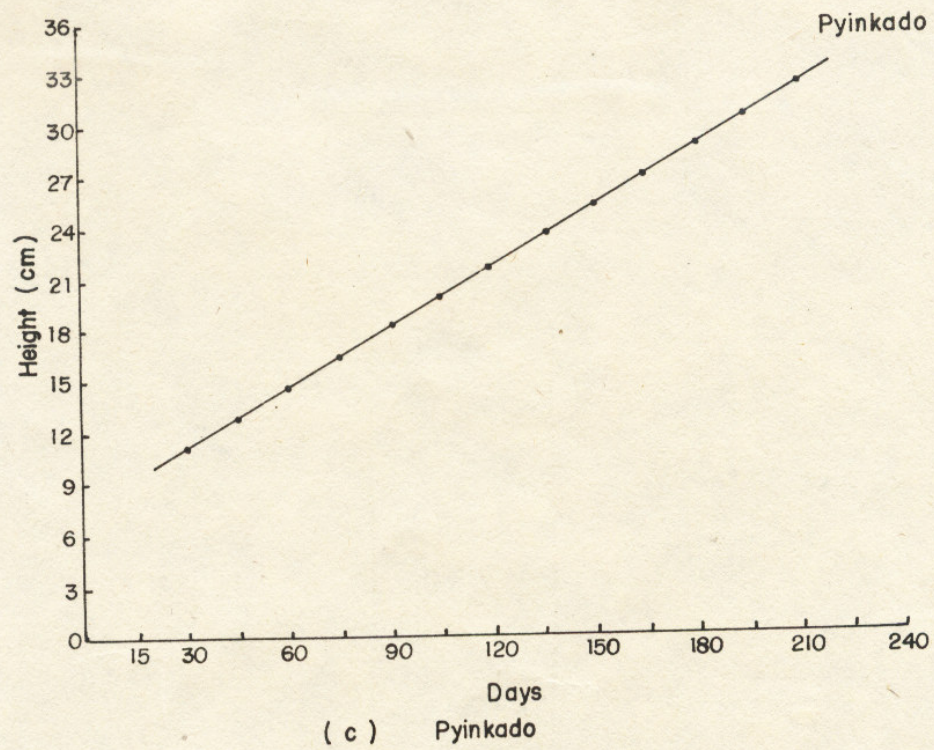


Figure 12. Height Growth

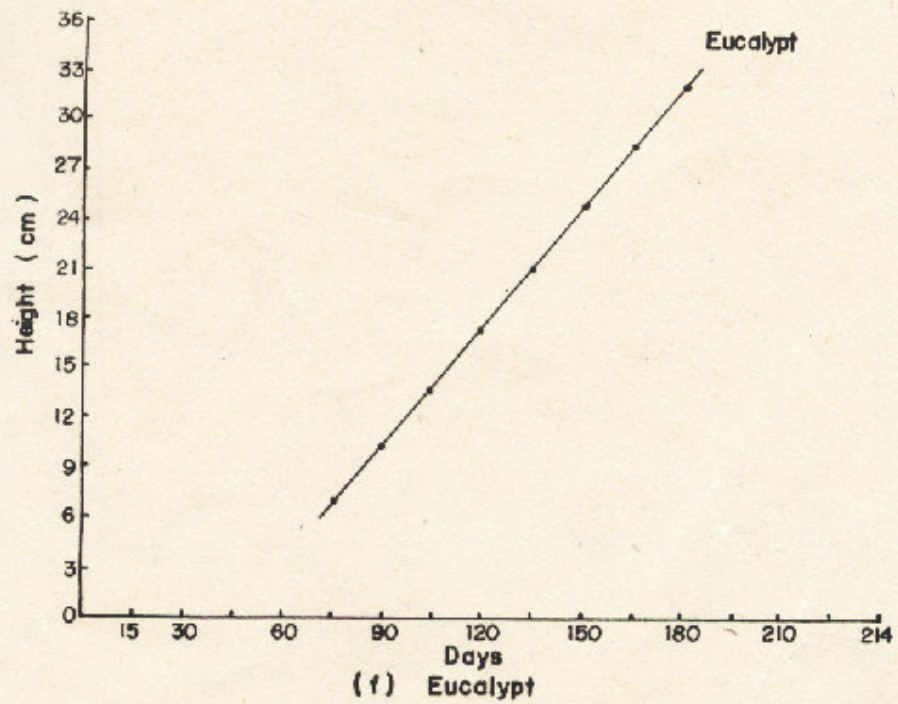
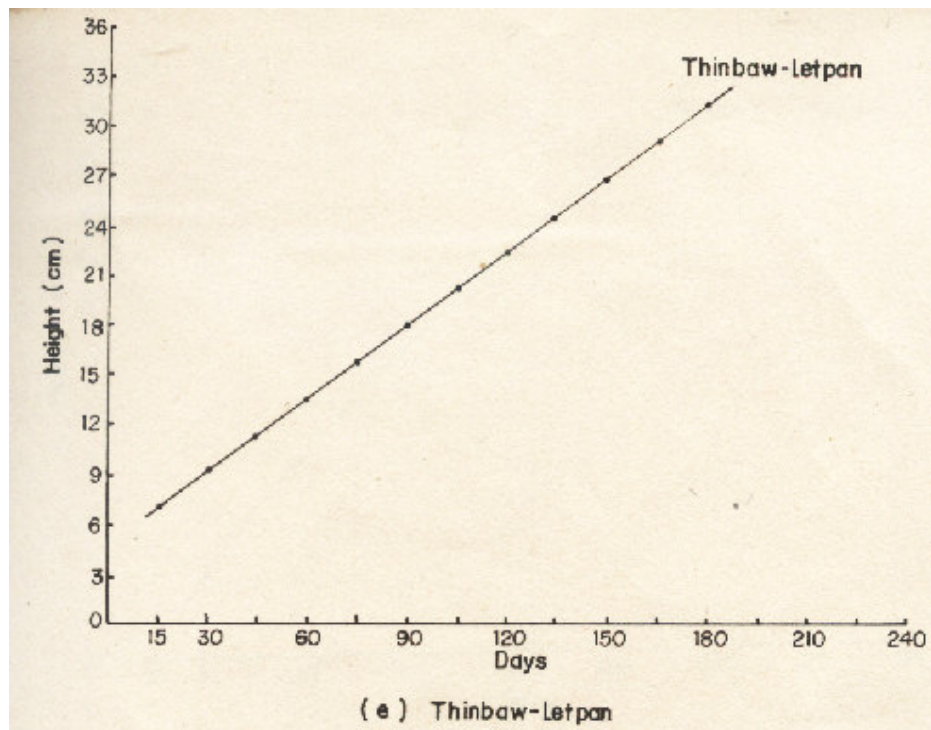
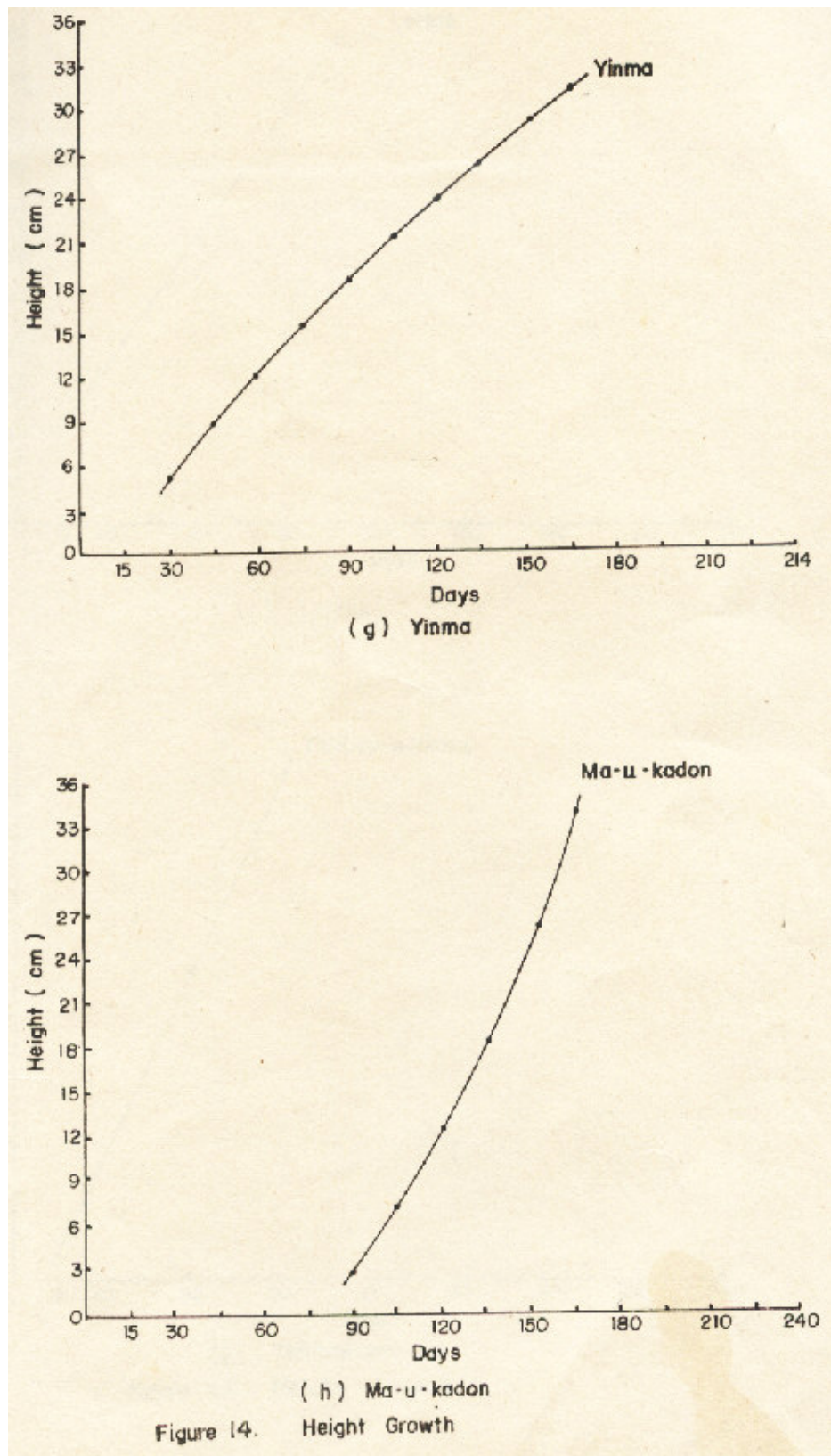
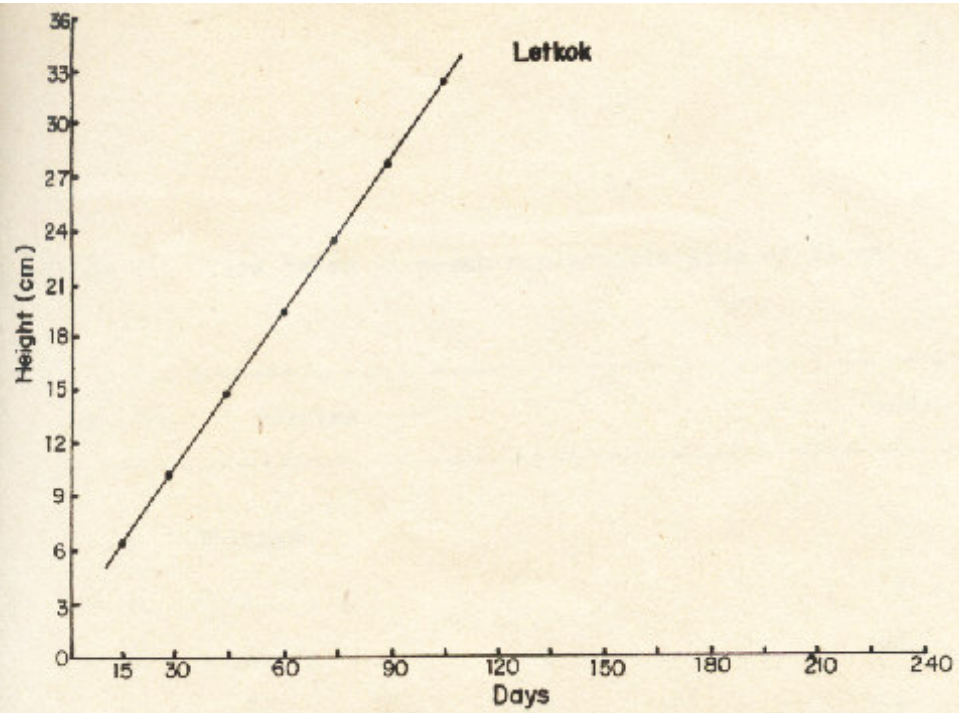
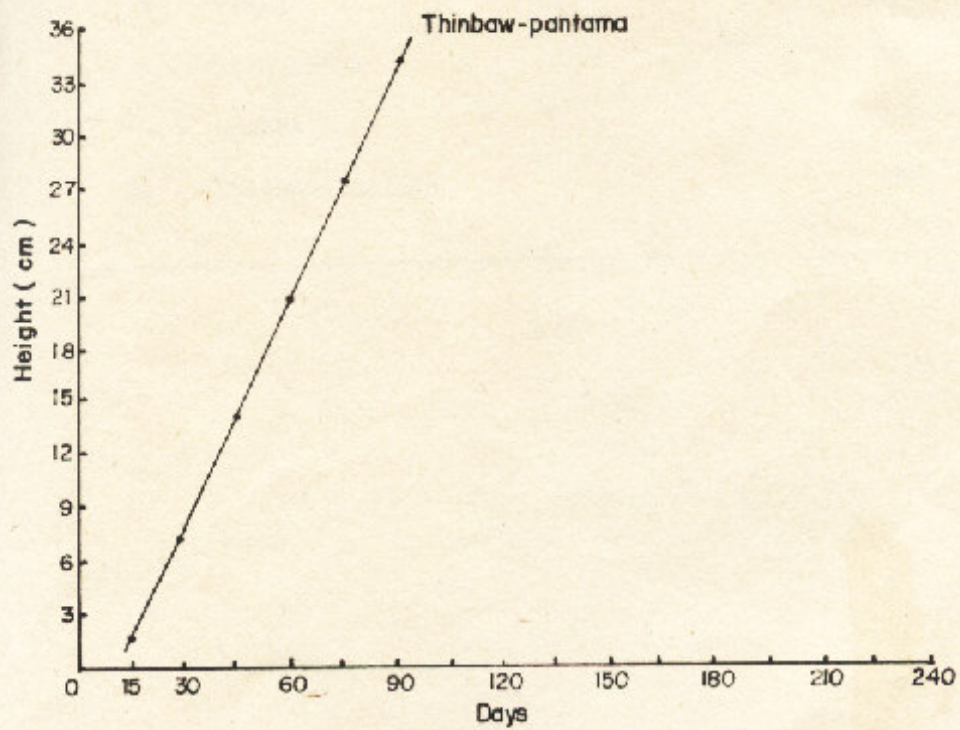


Figure.13. Height Growth





(i) Letkok



(j) Thinbaw-pantama

Figure. 15. Height Growth

Table 5. Time taken to reach a plantable size of 31 cm.

Sr. No.	Species	Days
(1)	Thitkado	227
(2)	Gyok	217
(3)	Pyinkado	199
(4)	Kabwi	178
(5)	Thinbaw-letpan	178
(6)	Eucalypt	177
(7)	Yinma	162
(8)	Ma- u- kadon	159
(9)	Letskok	100
(10)	Thinbaw- pantama	83

Pyinkado - Out of the three pretreatments applied partial scarification was the best, and was followed by soaking in cold water and control. The germination percent increased from the normal 62 % to 78 % and 87 % respectively. Similarly G.V also increased from the normal 15.9 to 63.42 and 124.13 respectively.

Letskok - Letskok seeds after being pretreated with soaking in cold water increased in germination from the normal 75 % to 90 %. GV also increased from 10.85 to 58.57.

Gyok - Gyok seeds after being soaked in cold water for 24 hours increased in germination from the normal 60 % to 86 %. GV also increased from 6.02 to 19.03.

Thinbaw-letpan - Thinbaw-letpan seeds after being soaked in cold water for 24 hours increased in germination from the normal 55 % to 61 %. GV also increased from 5.65 to 21.18.

Thinbaw-pantama - The seeds after being soaked in cold water for 24 hours increased in germination from the normal 58% to 74% G. Valso increased from 3.34 to 11.17.

Thitkado, Yinma, Kabwi, Eucalypt and Ma-u-kadon gave reasonably good germination without being pretreated i.e. 69.7%, 75.0%, 66.25%, 74.25% and 13% / 0.5 gm. Moreover the seeds were very minute and abundance in number and were therefore considered to be unnecessary to be pretreated.

Seedling Height Growth

Seedling height growth was as given in table 5 and figure 11,12,13,14 and 15. In order to reach a plantable size of 31 cm in height, Thitkado took (227) days, Gyok (217) days, Pyinkado (199) days, Kabwi (178) days, Thinbaw-letpan(178) days, Eucalypt (177) days, Yinma(162) days, Ma-u-kadon (159) days, Letskok (100) days and Thinbaw-pantama took (83) days.

4. Discussion

In the first volume of the series, seed collection, seed processing, seed storage, seed pretreatment, seed germination and assessment of seedling height growth were widely discussed.

Due to the differences in localities where seeds were collected, variation in seed per unit volume and time of collection for the same species must be expected.

Pyinkado - It is very important to collect Pyinkado seeds at the right time. The pods explode when ripe and the seeds got scattered to a considerable distance (Thein Lwin, et.al. 1974). Thus seed collection should be done by climbing and picking with an extended pruner before they are fully ripe.

Pyinkado seed after being sun dried for 3 days was said to be able to store for one year. However, the present study revealed that under such storage condition, the germination percent of the seeds started dropping from the 6th month of storage. Only 35% germination was obtained on the 12th month of storage. Storage under air-conditioned room was the best (See Table 2).

Thitkado - This is another important and fast growing indigenous species (Troup 1921 a). The seed of this species should also be collected before it is fully ripe and the capsules opened. Seed collected from the ground was said to give very low germination.

Time of fruiting seemed to vary considerably with locations (Troup 1921 a). In Taungoo, seeds were ready for collection from April till May. According to Troup (1921 a) seed failed to germinate after being kept for one year. It was found that they can be stored for only 3 months under room temperature (See Table 2). Although the germination dropped gradually, the seeds can be stored appreciably well for 13 months under refrigeration.

Although the species grows rapidly in the field, with a maximum of over 1.5 m in the second year, the growth during the nursery stage is comparatively very slow (See Table 5).

Yinma - This is also another important and fast growing species. Growth during nursery stage is moderate (See Table 5), but increase noticeably during the first year in the field and astoundingly noticeable in the second year (Troup 1921 a).

The seed will not retain its viability for a year (Troup 1921 a). Germination dropped from 69 % to 36 % after being stored at room temperature for 5 months. It can however be stored reasonably well for over 2 years under air-condition or refrigeration room.

Ma-u-kadon - This is a species of secondary importance. According to Troup (1921 b), the seed ripens from January- February in Bangal Duars. However, collection at Moswe, (Pinyinmana Township) for this study was carried out between September and October.

The low germination obtained from the seed of this species (6%-11%) was compensated by the numerous minute seed it produced. It can be stored for only 4 months under room temperature. However, it gave reasonably good germination after being stored for 18 months under refrigeration.

Letkok - This is a species of secondary importance. Seeds of this species can be collected from February till March. Fresh seeds gave very good germination (90%). It can be stored reasonably well for 10 months under room temperature. However, it can be stored for a much longer period in air-conditioned room.

Gyok - This species is very good for making shuttle. According to Troup (1921 b), the fruits can be collected from December to February. However, studies for time of collection at Yamethin showed that they can be collected from October to November. Fresh seeds gave very high germination percent being over 80%. The seeds can be stored for over a year under air-conditioned room but lose their viability if stored in room temperature for more than 9 months. They were very slow growing both in the nursery and in the field.

Thinbaw-letpan - This species is well known for the floss it produced. These floss are widely used for making mattresses and pillows.

The fruits ripen during October to November in Java, March to April in India and Mid-dry season in Northern Australia (Troup 1921 a, Hearne 1975, Council of Scientific & Industrial Research, 1981). In Yezin the fruit ripen from April to May. They can be stored reasonably well for over 2 years in room temperature. Growth is reasonable in the nursery but is fast growing in the field (Hearne 1975).

Kabwi - This is also a fast growing species in the field. However, growth during nursery stage is comparatively slow (See Table 5).

According to the National Research Council (1984), flowering and fruiting occur throughout the year in warm climate. For this study, seeds were collected at Yezin from February to June.

Seed should not be stored for more than 7 months under room temperature. However, it can be stored for more than two years under refrigeration.

Thinbaw-pantama - This species is another very fast growing species. According to Troup (1921 a) the fruits ripen in the cold season. However, the present study revealed that seeds can be collected before the cold season i.e., in September till October. The seeds can be stored appreciably well for 2 years under room temperature. However, it can be stored better still in air-conditioned room.

Thinbaw-pantama is very fast growing both in the nursery and in the field.

Eucalypt - Eucalypts is also another fast growing species which also grows reasonably fast in the nursery.

Time for seed collection varies according to localities (FAO, 1955). In Yezin, seed can be collected from June till July.

Eucalypt seed was said to have germinated after being stored at room temperature for 30 years. (Krugman, 1974). Germination however was low. Present study showed that the seeds of this species germinate reasonably well after being stored for 29 months in room temperature. However, it stored best under refrigeration.

5. Conclusion

In conclusion, it is recommended that.

(1) After collection and processing Pyinkado, Letkok, Gyok, Thinbaw-letpan, and Thinbaw-pantama should be stored in air-conditioned room while Thitkado, Yinma, Ma-u- kadon, Kabwi and Eucalypt should be stored under refrigeration. Yinma and Eucalypt can also be stored in air-conditioned room where refrigeration is not available.

(2) Before germination, Letskok, Gyok, Thinbaw-letpan and Thinbaw-pantama should be soaked in cold water for one day in order to get good germination. The same pretreatment can be applied to Pyinkado however partial scarification will give better results. The remaining five species need no pretreatment.

(3) When planning nursery work the following species should be sown prior to the date of planting out in the field as follows; Thitkado 230 days, Gyok 220 days, Pyinkado 200 days, Kabwi 180 days, Thinbaw-letpan 180 days, Eucalypt 180 days, Yinma 160 days, Ma-u- kadon 160 days, Letskok 100 days and Thinbaw-pantama 80 days.

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